7. BYCATCH, INCIDENTAL CATCH, AND PROTECTED SPECIES

In 1998, NMFS developed a national bycatch plan, *Managing the Nation's Bycatch* (NMFS, 1998), which includes programs, activities, and recommendations for federally managed fisheries. The national goal of NMFS's bycatch plan activities is to implement conservation and management measures for living marine resources that will minimize, to the extent practicable, bycatch and the mortality of bycatch that cannot be avoided. Inherent in this goal is the need to avoid bycatch, rather than create new ways to utilize bycatch. The plan also established a definition of bycatch as fishery discards, retained incidental catch, and unobserved mortalities resulting from a direct encounter with fishing gear. Further discussion of fishery bycatch, incidental catch, and protected species, including standardized reporting of bycatch, bycatch reduction in HMS fisheries, and evaluation and monitoring of bycatch, is available in this chapter of the 2011 HMS SAFE Report. The bycatch in each HMS fishery is summarized and reported annually in the HMS SAFE Report. The effectiveness of bycatch reduction measures is evaluated based on this summary.

7.1 Bycatch Reduction and the Magnuson-Stevens Act

According to the Magnuson-Stevens Act, "The term 'bycatch' means fish which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic discards and regulatory discards. Such term does not include fish released alive under a recreational catch and release fishery management program." Fish is defined as finfish, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds. Birds and marine mammals are therefore not considered bycatch under the Magnuson-Stevens Act, but are examined as incidental catch.

National Standard 9 of the Magnuson-Stevens Act requires that fishery conservation and management measures shall, to the extent practicable, minimize bycatch and minimize the mortality of bycatch that cannot be avoided. In many fisheries, it is not practicable to eliminate all bycatch and bycatch mortality. Some relevant examples of fish caught in Atlantic HMS fisheries that are included as bycatch or incidental catch are marlin, undersized swordfish, and bluefin tuna caught by commercial fishing gear; undersized swordfish and tunas in recreational hook and line fisheries; species for which there is little or no market such as blue sharks; and species caught and released in excess of a bag limit.

7.1.1 Standardized Bycatch Reporting Methodology

Section 303(a)(11) of the MSA requires all FMPs to "establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery" (16 U.S.C. § 1853(11)). The scope of the Standardized Bycatch Reporting Methodology (SBRM) requirement is limited to the MSA definition of "bycatch." The MSA defines bycatch as "fish which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic discards and regulatory discards" (16 U.S.C. § 1802(2)). As clarified in the definition, bycatch "does not include fish released alive under a recreational catch and release fishery management program" (16 U.S.C. § 1802(2)).

The MSA definition of "fish" includes "finfish, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds" (16 U.S.C. §

1802(12)). Therefore, the SBRM requirement applies to bycatch of finfish, shellfish, coral, all other marine invertebrates, marine plants, sea turtles, etc., but does not include marine mammals or seabirds. The National Standard 9 Guidelines (50 C.F.R. § 600.350) provides further clarification of the MSA's definition of bycatch. The Endangered Species Act and the Marine Mammal Protection Act create additional important bycatch-related responsibilities for NOAA Fisheries.

In 2004, NMFS published a technical memorandum that provided information that could be used to develop standardized reporting methodologies, including recommended objectives, protocols, and precision goals (NMFS 2004). The development and documentation of this methodology establishes the SBRM for a fishery. Appendix 5 of the report specifies the protocols for SBRMs established by NMFS throughout the country. NMFS published the First Edition of the U.S. National Bycatch Report in 2011 (NMFS 2011b), which documented bycatch estimates, using observer data and self-reported logbook data, for all fisheries for which this information was available in 2005. The First Edition Update 1 (data through 2010) to the U.S. National Bycatch Report became available in 2014. The 2014 update, as well as the First Edition of the report, is available at: http://www.fisheries.noaa.gov/by_catch/bycatch_nationalreport.htm. NMFS anticipates the next update to the National Bycatch Report, which will include data through 2013, will be publicly available late in 2015. The U.S. National Bycatch Report includes descriptions of the Atlantic and Gulf of Mexico shark bottom longline fishery, pelagic longline fishery, and southeast large coastal and small coastal shark drift, strike, and bottom gillnet fisheries; gear types; some methods used to reduce bycatch and bycatch mortality in each fishery; and bycatch data sources as well as bycatch estimations and estimation methodology.

NMFS utilizes self-reported logbook data (Fisheries Logbook System or FLS, and the supplemental discard report form in the reef fish/snapper-grouper/king and Spanish mackerel/shark logbook program), at-sea observer data, and survey data (recreational fishery dockside intercept and telephone surveys) to produce bycatch estimates in HMS fisheries. The incidental catch of bluefin tuna in the pelagic longline fishery is also monitored via electronic monitoring (camera array) and catch reporting via vessel monitoring systems and dead discards of bluefin tuna in the harpoon and hook and line fisheries are self-reported via reporting. All bycatch data are collected with respect to fishing gear type. The number and location of discarded fish are recorded, as is the disposition of the fish (i.e., released alive vs. released dead). Post-release mortality of HMS are accounted for in stock assessments to the extent that the data allow.

The fishery logbook systems in place are mandatory programs, and it is expected that the reporting rates are generally high (Garrison, 2005). Due to the management focus on HMS fisheries, there has been close monitoring of reporting rates, and observed trips can be directly linked to reported effort. In general, the gear characteristics and amount of observed effort is consistent with reported effort. However, under-reporting is possible, which can lead to a negative bias in bycatch estimates. Cramer (2000) compared dead discards of undersized swordfish, sailfish, white and blue marlin, and pelagic sharks from HMS logbook and Pelagic Observer Program (POP) data in the U.S. Atlantic PLL fishery. Cramer (2000) provided the ratio of catch estimated from the POP data divided by the reported catch in the HMS logbooks. The ratio indicated the amount of underreporting for each species in a given area. However, the data analyzed by Cramer (2000) was based on J-hook data from 1997 – 1999 and that gear is

prohibited now. In some instances, logbooks are used to provide effort information against which bycatch rates obtained from observers is multiplied to estimate bycatch. In other sectors/fisheries, self-reporting provides the primary method of reporting bycatch.

A review of the bycatch reporting methodologies for all HMS fisheries through 2010 was provided in the 2011 SAFE Report (NMFS 2011a). Updates for bycatch reporting methodologies (where changes in methodologies have occurred) and updated information on observer coverage rates (for fisheries with observer coverage) are provided in the respective Fishery Data Update sections: Section 4.1 (Pelagic Longline); Section 4.2 (Purse Seine); Section 4.3 (Commercial Handgear); Section 4.5 (Bottom Longline); and Section 4.6 (Gillnet Fishery). Future adjustments may be implemented as needed due to changing conditions in the fisheries or based on additional research. Further analyses of bycatch in the various HMS fisheries may be conducted as warranted.

7.2 Evaluation and Monitoring of Bycatch in HMS Fisheries

The identification of bycatch in Atlantic HMS fisheries is the first step in reducing bycatch and bycatch mortality. The Magnuson-Stevens Act requires the amount and type of bycatch to be summarized in the annual SAFE reports. A summary of bycatch species, data collection methods, and management measures by fishery/gear type is found in Table 7.1.

Pelagic longline fishery dead discards of swordfish, bluefin tuna, billfish, large coastal sharks, and pelagic sharks are estimated using data from NMFS observer reports and logbook reports. Shark bottom longline and shark gillnet fishery discards can be estimated using logbook data and observer reports as well.

NMFS has not estimated bycatch in the swordfish harpoon fishery. NMFS has limited historical observer data on harpooned swordfish from driftnet trips in which harpoons were sometimes used. Swordfish harpoon fishermen are required to submit pelagic logbooks and NMFS can examine those for their utility in estimating bycatch. NMFS has not estimated bycatch in the bluefin tuna harpoon fishery because these fishermen have not been selected to submit logbooks. NMFS has not estimated bycatch in the General category commercial rod and reel tuna fishery although anecdotal evidence indicates that some undersized bluefin tuna may be captured. Effective in 2015, Amendment 7 to the 2006 Consolidated HMS FMP implemented requirements for commercial handgear fishermen, including General and Harpoon category fishermen, to report bluefin tuna dead discards online, which will allow for estimates of those geartypes' bycatch in the future.

The accuracy of discard estimates in the recreational rod and reel fishery for Atlantic HMS is uncertain due to the low number of observations by the Large Pelagics Survey (LPS) and the Marine Recreational Information Program (MRIP). Recreational bycatch estimates (numbers of fish released alive and dead) are not currently available, except for bluefin tuna. For some species, encounters are considered rare events, which might result in bycatch estimates with considerable uncertainty. Due to improvements in survey methodology, increased numbers of intercepts (interviews with fishermen) have been collected since 2002. NMFS may develop bycatch estimates (live and dead discards) and estimates of uncertainty for the recreational fishery from the LPS. These data will be included in future HMS SAFE Reports. Bycatch estimates may also be examined for the recreational fishery with the use of tournament data.

Table 7.1 Summary of Bycatch Species, Marine Mammal Protection Act Category, Endangered Species Act Requirements, Data Collection, and Management Measures (Year Implemented) for HMS Fisheries, by Fishery/Gear Type

Fishery/Gear Type	Bycatch Species	MMPA Category	ESA Requirements	Bycatch Data Collection	Management Measures
Pelagic longline	Bluefin tuna Billfish Undersize target species Marine mammals Sea turtles Seabirds Non-target finfish Prohibited shark species Large coastal shark species after closure	Category I	Jeopardy findings in 2000 & 2004; Reasonable and Prudent Alternative implemented 2001-04; ITS, Terms & Conditions, RPMs; Consultation reinitiated in 2014	Permit requirement (1985); logbook requirement (SWO-1985; SHK - 1993); observer requirement (1992), EFPs (2001-present)	BFT target catch requirements (1981); quotas (SWO - 1985; SHK - 1993); prohibit possession of billfish (1988); minimum size (1995); gear marking (1999); line clippers, dipnets (2000); MAB closure (1999); limited access (1999); limit the length of mainline (1996-1997 only); move 1 nm after an interaction (1999); voluntary vessel operator workshops (1999); GOM closure (2000); FL, Charleston Bump, NED closures (2001); gangion length, corrodible hooks, de-hooking devices, handling & release guidelines (2001); NED experiment (2001-03); VMS (2003); circle hooks and bait requirements (2004); mandatory safe handling and release workshops (2006); sea turtle control device (2008); closed area research (2008-10); marine mammal handling and release placard, 20 nm mainline restriction in MAB, observer and research requirements in Cape Hatteras Spec. Research Area (CHSRA), increased observer coverage in Atl PLL fishery (2009), weak hook requirement in GOM (2011); Amendment 7 Individual Bluefin Quotas, Gear Restricted Areas, Electronic Monitoring, VMS reporting (2015)
Shark bottom longline	Prohibited shark species Target species after closure Sea turtles Smalltooth sawfish Non-target finfish	Category III	ITS, Terms & Conditions, RPMs	Permit requirement (1993); logbook requirement (1993); observer coverage (1994)	Quotas (1993); trip limit (1994); gear marking (1999); handling & release guidelines (2001); line clippers, dipnets, corrodible hooks, de-hooking devices, move 1 nm after an interaction (2004); South Atlantic closure, VMS (2005); shark identification workshops for dealers (2007); sea turtle control device (2008); shark research fishery (2008)
Shark gillnet	Prohibited shark species Sea turtles	Category II	ITS, Terms & Conditions, RPMs	Permit requirement (1993); logbook requirement (1993);	Quotas (1993); trip limit (1994); gear marking (1999); deployment restrictions (1999); 30-day closure for leatherbacks (2001); handling & release guidelines

Fishery/Gear Type	Bycatch Species	MMPA Category	ESA Requirements	Bycatch Data Collection	Management Measures
	Marine mammals Non-target finfish Smalltooth sawfish			observer coverage (1994)	(2001); net checks (2002); whale sighting (2002); VMS (2004; revised 2016); closure for right whale mortality (2006); shark identification workshops for dealers (2007); gillnet soak time limits (2016)
Bluefin tuna purse seine	Undersize target species Non-target finfish	Category III	ITS, Terms & Conditions	Permit requirement (1982); observer requirement (1996, 2001 only); EFPs (2002-03)	Quotas (1975); limited access, individual vessel quotas (1982); minimum size (1982); Amendment 7 VMS requirements and reporting (2015)
Bluefin tuna & swordfish harpoon	Undersize target species	Category III	ITS, Terms & Conditions	Permit requirement (BFT - 1982; SWO - 1987); SWO logbook requirement (1987)	Quotas (BFT - 1982; SW0 - 1985); minimum size (BFT - 1982; SWO - 1985); Amendment 7 online catch reporting (2015)
Handgear - commercial	Undersize target species Non-target finfish	Category III	ITS, Terms & Conditions	Permit requirement (BFT - 1982; SWO 1987; SHK - 1993); logbook requirement (SWO - 1985; SHK - 1993)	Regulations vary by species, including quotas, minimum sizes, retention limits, landing form; Amendment 7 online catch reporting (2015)
Handgear - recreational	Undersize target species Non-target finfish	Category III	ITS, Terms & Conditions	Large Pelagics Survey (1992); MRFSS (1981)	Regulations vary by species, including minimum sizes, retention limits, landing form; BFT quotas

MMPA – Marine Mammal Protection Act; ESA – Endangered Species Act; ITS – Incidental take statement; MRFSS – Marine Recreational Fishing Statistics Survey; EFPs – Exempted fishing permits; BFT – Bluefin tuna; SWO – Swordfish; SHK – Shark; GOM – Gulf of Mexico; NED – North East Distant; MAB – Mid Atlantic Bight; PLL – Pelagic longline; VMS – Vessel monitoring system.

7.2.1 Bycatch Mortality

The reduction of bycatch mortality is an important component of National Standard 9. Physical injuries to fish may not be apparent to the fisherman who is quickly releasing the fish because there may be injuries associated with the stress of being hooked or caught in a net. Little is known about the mortality rates of many of the species managed under this FMP, but there are some data for certain species. Information on bycatch mortality of these fish should continue to be collected, and in the future, could be used to estimate bycatch mortality in stock assessments.

NMFS submits annual data (Task II) to ICCAT on mortality estimates (dead discards). These data are included in the HMS SAFE reports and U.S. National Reports to ICCAT to evaluate bycatch trends in HMS fisheries.

Pelagic Longline Fishery

NMFS collects data on the disposition (released alive or dead) of bycatch species from logbooks submitted by fishermen in the PLL fishery. Observer reports also include disposition of the catch as well as information on hook location, trailing gear, and injury status of protected species interactions. These data are used to estimate post-release mortality of sea turtles and marine mammals based on guidelines for each (Angliss and DeMaster 1998, Ryder et al. 2006).

Purse Seine Fishery

NMFS has limited observer data on the bluefin tuna purse seine fishery. There are no recorded instances of non-tuna finfish, other than minimal numbers of blue sharks, caught in tuna purse seines. Anecdotal evidence indicates that if fish are discarded, they are easily released out of the net with minimal bycatch mortality.

Bottom Longline Fishery

The shark BLL fishery has relatively low observed bycatch rates. Historically, finfish bycatch has averaged approximately five percent in the BLL fishery. Observed protected species bycatch (sea turtles) has typically been much lower, less than 0.01 percent of the total observed catch. Disposition of discards is recorded by observers and can be used to estimate discard mortality.

Shark Gillnet Fishery

Many shark gillnet fishermen have been targeting finfish rather than sharks as a result of Amendments 2 and 3 to the Consolidated Atlantic Highly Migratory Species Management Plan (NMFS 2007, 2010). Disposition of discards is recorded by observers and can be used to estimate discard mortality. There was one protected species interaction observed in any gillnet sets in 2014 (Mathers et al. 2015).

Commercial Handgear Fishery

Vessels targeting bluefin tuna with harpoon gear have not been selected for observer coverage since the deliberate fishing nature of the gear is such that bycatch is expected to be low. Therefore, there are no recorded instances of non-target finfish caught with harpoons and NMFS cannot quantify the bycatch of undersized bluefin tuna in this fishery. Effective in 2015,

Amendment 7 to the 2006 Consolidated HMS FMP implemented requirements for commercial handgear fishermen, including Harpoon category fishermen, to report bluefin tuna dead discards online, which will allow for estimates of this gear type's bycatch in the future. Bycatch in the swordfish harpoon fishery is expected to be virtually, if not totally, non-existent. Since bycatch approaches zero in this fishery, it follows that bycatch mortality is near zero. Disposition of bycatch reported in logbooks is used to estimate mortality of bycatch in the hook and line handgear fisheries.

Recreational Handgear Fishery

The LPS collects data on disposition of bycatch (released alive or dead) in recreational HMS fisheries. Rod and reel discard estimates from Virginia to Maine during June through October can be monitored through the expansion of survey data derived from the LPS (dockside and telephone surveys). However, the actual numbers of fish discarded for many species are low. Post-release mortality studies have been conducted on few HMS at this time. Summaries of those studies can be found in previous SAFE reports.

7.3 Protected Species Interactions in HMS Fisheries

This section examines the interaction between protected species and Atlantic HMS fisheries managed under the 2006 Consolidated HMS FMP. As a point of clarification, interactions are different than bycatch. Interactions take place between fishing gears and marine mammals and seabirds, while bycatch consists of the incidental take and discards of non-targeted finfish, shellfish, mollusks, crustaceans, sea turtles, and any other marine life other than marine mammals and seabirds. A more detailed review of the three acts (Marine Mammal Protection Act (MMPA), Endangered Species Act (ESA), and Migratory Bird Treaty Act (MBTA)) affecting protected species, along with a description of the Pelagic Longline Take Reduction Team (http://www.nmfs.noaa.gov/pr/interactions/trt/pl-trt.htm), Take Reduction Plan, and measures to address protected species concerns, is available in the 2011 HMS SAFE Report. The interaction of seabirds and longline fisheries are also considered under the United States "National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries" (NPOA – Seabirds). Bycatch of HMS in other fisheries is also discussed in the 2011 HMS SAFE Report, and estimates of blacknose shark bycatch in the shrimp fisheries are available in the most recent stock assessment, SEDAR 21 (Cortés and Baremore, 2011).

Protected Species – Reinitiation of ESA Section 7 Consultation in HMS Fisheries

On March 31, 2014, NMFS requested reinitiation of Section 7 consultation under the Endangered Species Act (ESA) on actions in the Atlantic pelagic longline fishery. Despite sea turtle takes that were lower than specified in the ITS, leatherback mortality rates and total mortality levels had exceeded the level specified in the reasonable and prudent alternatives (RPAs) in the 2004 biological opinion. Additionally, new information has become available about leatherback and loggerhead sea turtle populations and sea turtle mortality. While the mortality rate measure will be re-evaluated during consultation, the overall ability of the RPA to avoid jeopardy is not affected, and NMFS is continuing to comply with the terms and conditions of the RPA and RPMs pending completion of consultation. NMFS also has confirmed that there will be no irreversible or irretrievable commitment of resources that would foreclose the formulation or implementation of any reasonable and prudent alternative measures pending completion of consultation, consistent with section 7(d) of the Act.

On July 3, 2014, NMFS issued the final determination to list the Central and Southwest Atlantic Distinct Population Segment (DPS) of scalloped hammerhead shark (*Sphyrna lewini*) as threatened species pursuant to the ESA. On August 27, 2014, NMFS published a final rule to list the following 20 coral species as threatened: five in the Caribbean including Florida and the Gulf of Mexico (*Dendrogyra cylindrus*, *Orbicella annularis*, *O. faveolata*, *O. franksi*, and *Mycetophyllia ferox*); and 15 in the Indo-Pacific (*Acropora globiceps*, *A. jacquelineae*, *A. lokani*, *A. pharaonis*, *A. retusa*, *A. rudis*, *A. speciosa*, *A. tenella*, *Anacropora spinosa*, *Euphyllia paradivisa*, *Isopora crateriformis*, *Montipora australiensis*, *Pavona diffluens*, *Porites napopora*, and *Seriatopora aculeata*). Additionally, in that August 2014 rule, two species that had been previously listed as threatened (*A. cervicornis* and *A. palmata*) in the Caribbean were found to still warrant listing as threatened.

The Central and Southwest Atlantic DPS of scalloped hammerhead sharks and seven Caribbean species of corals have been determined to occur within the management area of Atlantic HMS fisheries. Therefore, on October 30, 2014, NMFS requested reinitiation of ESA Section 7 consultation on the continued operation and use of several HMS gear types (bandit gear, bottom longline, buoy gear, handline, and rod and reel) and associated fisheries management actions in the 2006 Consolidated Atlantic HMS FMP and its amendments. These management actions were previously consulted on in the 2001 Atlantic HMS biological opinion and the 2012 Shark and Smoothhound biological opinion, to assess potential adverse effects of these gear types on the Central and Southwest DPS of scalloped hammerhead sharks and seven threatened coral species. NMFS has preliminarily determined that the ongoing operation of the fisheries is consistent with existing biological opinions and is not likely to jeopardize the continued existence or result in an irreversible or irretrievable commitment of resources which would foreclose formulation or implementation of any reasonable and prudent alternative measures on the threatened coral species.

With regard to the ongoing reinitiation of ESA Section 7 consultation on the Atlantic PLL fishery, the effects of HMS fishery interactions with the central and southwest Atlantic DPS of scalloped hammerhead shark and the seven threatened coral species will be considered in the ongoing PLL consultation. This will most effectively evaluate the effects of the PLL fishery on all listed species in the action area.

7.3.1 Interactions and the Marine Mammal Protection Act

Under MMPA requirements, NMFS produces an annual List of Fisheries (LOF) that classifies domestic commercial fisheries, by gear type, relative to their rates of incidental mortality or serious injury of marine mammals. The LOF includes three classifications:

1. Category I fisheries are those with frequent serious injury or mortality to marine mammals;
2. Category II fisheries are those with occasional serious injury or mortality; and
3. Category III fisheries are those with remote likelihood of serious injury or mortality to marine mammals.

The final 2015 MMPA LOF was published on January 28, 2015 (79 FR 77919); the proposed 2016 MMPA LOF was published on September 29, 2015 (80 FR 58427). The Atlantic

Ocean, Caribbean, and Gulf of Mexico large PLL fishery is classified as Category I (frequent serious injuries and mortalities incidental to commercial fishing) and the southeastern Atlantic shark gillnet fishery is classified as Category II (occasional serious injuries and mortalities). A summary of the observed and estimated marine mammal interactions with the PLL fishery is presented in Table 4.9. The following Atlantic HMS fisheries are classified as Category III (remote likelihood or no known serious injuries or mortalities): Atlantic tuna purse seine; Gulf of Maine and Mid-Atlantic tuna, shark and swordfish, hook-and-line/harpoon; southeastern Mid-Atlantic and Gulf of Mexico shark BLL; and Mid-Atlantic, southeastern Atlantic, and Gulf of Mexico pelagic hook-and-line/harpoon fisheries. Commercial passenger fishing vessel (charter/headboat) fisheries are subject to Section 118 and are listed as a Category III fishery. Recreational vessels are not categorized since they are not considered commercial fishing vessels.

Fishermen participating in Category I or II fisheries are required to register under the MMPA and to accommodate an observer aboard their vessels if requested. Vessel owners or operators, or fishermen, in Category I, II, or III fisheries must report all incidental mortalities and serious injuries of marine mammals during the course of commercial fishing operations to NMFS. There are currently no regulations requiring recreational fishermen to report takes, nor are they authorized to have incidental takes (i.e., they are illegal).

7.3.2 Interactions and the Endangered Species Act (ESA)

Sea Turtles

NMFS has taken numerous steps in the past few years to reduce sea turtle bycatch and bycatch mortality in domestic longline fisheries. A summary of those steps can be found in Chapter 4 and previous SAFE reports. As noted in Chapter 4, sea turtle interactions have decreased since these steps have been taken.

Smalltooth Sawfish

NMFS designated critical habitat for smalltooth sawfish in September 2009 (74 FR 45353). NMFS believes that smalltooth sawfish takes in the shark gillnet fishery are rare given the low reported number of takes and high rate of observer coverage. The fact that there were no smalltooth sawfish caught during 2001, when 100 percent of the fishing effort was observed, indicates that smalltooth sawfish takes (observed or total) most likely do not occur on an annual basis. Based on this information, the 2003 biological opinion estimated that one incidental capture of a sawfish (released alive) over five years would occur as a result of the use of gillnets in this fishery (NMFS, 2003a). No smalltooth sawfish were observed in shark gillnet fisheries for 2012.

Interactions with Seabirds

The NPOA-Seabirds (http://www.nmfs.noaa.gov/ia/species/seabirds/us_npoa.pdf) was released in February 2001, and calls for detailed assessments of longline fisheries, and, if a problem is found to exist within a longline fishery, for measures to reduce seabird bycatch within two years. Because interactions appear to be relatively low in Atlantic HMS fisheries, the adoption of immediate measures is unlikely. The 2014 Report on the Implementation of the United States National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline

Fisheries was submitted to the UN FAO in June 2014 and can be found here http://www.nmfs.noaa.gov/ia/resources/publications/ccrf/longline_fisheries.pdf.

Gannets, gulls, greater shearwaters, and storm petrels are occasionally hooked in the Atlantic pelagic longline fishery. These species and all other seabirds are protected under the MBTA. The majority of longline interactions with seabirds occur as the gear is being set. The birds eat the bait and become hooked on the line. The line then sinks and the birds are subsequently drowned.

Bycatch of seabirds in the shark BLL fishery has been virtually non-existent. A single pelican has been observed killed from 1994 through 2013. No expanded estimates of seabird bycatch or catch rates for the BLL fishery have been made due to the rarity of seabird takes.

7.4 Bycatch of HMS in Other Fisheries

The following section summarizes the bycatch of HMS in any federal or state-managed fishery which captures them. More detailed information, including a description of HMS bycatch in the menhaden purse seine fishery, was presented in the 2011 HMS SAFE Report. NMFS continues to solicit bycatch data on HMS from all state, interjurisdictional, and Federal data collection programs.

7.4.1 Squid Mid-Water Trawl

U.S. squid trawl fishermen, using mid-water gear, landed 5.6 mt ww of yellowfin tuna, skipjack tuna, albacore tuna, bigeye tuna, and swordfish in 2014 incidental to the squid, mackerel, and butterfish trawl fishery (Table 7.2). Bycatch of HMS in other trawl fisheries may be included as a portion of the overall reported trawl landings in Table 7.2. Landings increased from 2013 for swordfish; however, pre-2013 swordfish landings were an order of magnitude higher. Swordfish landings remain low relative to the directed fishery landings. An Incidental HMS Squid Trawl permit allows squid trawl fishermen with an *Illex* squid trawl moratorium permit to land up to 15 swordfish per trip, although regulatory discards may still occur.

Table 7.2 Atlantic HMS Landed (mt ww) Incidental to Trawl Fisheries (2007-2014)

Species	2007	2008	2009	2010	2011	2012	2013	2014
Yellowfin tuna	2.40	0.00	0.0	1.4	1.3	0.2	0.0	0.3
Skipjack tuna	<0.01	<0.01	0.0	0.0	0.0	0.006	0.0	0.0
Bigeye tuna	0.40	0.00	0.0	0.7	1.2	0.2	0.0	0.0
Albacore tuna	0.30	0.01	0.08	0.2	2.0	0.3	0.0	0.0
Swordfish	6.50	7.60	22.7	21.2	17.9	26.8	2.9	5.3
Total	9.61	7.61	22.8	22.5	22.4	27.6	2.9	5.6

Source: NMFS, 2014.

7.4.2 Shrimp Trawl Fishery

For a summary of shark bycatch in the shrimp trawl fishery, please see the 2011 HMS SAFE Report. More recent estimates of blacknose shark bycatch in the shrimp fisheries can be found in the most recent blacknose stock assessment, SEDAR 21 (Cortés, E. and I. Baremore, 2011). Estimates of Atlantic sharpnose and bonnethead shark bycatch in the shrimp fisheries can be found in the most recent stock assessment reports for each (SEDAR 34).

7.5 Existing Pelagic Longline Time/Area Closures and Gear Restriction Efficacy in Reducing Bycatch

Since 2000, NMFS has implemented a number of time/area closures and gear restrictions in the Atlantic Ocean and Gulf of Mexico for the PLL fishery to reduce discards and bycatch of a number of species (juvenile swordfish, bluefin tuna, billfish, sharks, sea turtles, etc.). Circle hooks are required for the entire PLL fishery since July 2004. In May 2011, NMFS implemented a requirement that only "weak" circle hooks be used in the Gulf of Mexico PLL fishery in order to reduce the bycatch of bluefin tuna. Weak hooks are made with thinner wire (no larger than 3.65 mm in diameter) than standard hooks, which allows them to bend more easily and release large bluefin tuna quickly, thus allowing them to escape. Preliminary analyses of the effectiveness of the closures and combined closures and circle hook requirement are summarized here. Preliminary analysis of the effectiveness of weak hooks is being conducted. A brief summary of the prohibition of live bait in the Gulf of Mexico PLL fishery is available in the 2011 HMS SAFE Report. Amendment 7, effective January 1, 2015, implemented gear restricted areas for the PLL fishery in the Gulf of Mexico and Atlantic in order to reduce interactions between PLL gear and bluefin tuna. The Amendment 7 Gulf of Mexico GRAs prohibit the use of PLL gear during April and May, and the Amendment 7 Cape Hatteras GRA provides conditional access to the area for vessels fishing with PLL during December through April. Data from the PLL fishery from 2015 will be available during 2016, which may contribute toward evaluation of the efficacy of the GRAs.

The combined effects of the individual area closures and gear restrictions were examined by comparing the reported catch and discards from 2005-2014 to the averages for 1997-1999 throughout the U.S. Atlantic fishery. Previous analyses attempted to examine the effectiveness of the time/area closures only by comparing the 2001-2003 reported catch and discards to the base period (1997-1999) chosen and are included here for reference. The percent changes in the reported numbers of fish caught and discarded were compared to the predicted changes from the analyses in Regulatory Amendment 1 to the 1999 FMP (NMFS, 2000). Overall effort, expressed as the number of hooks reported set, declined by 23.7 percent during 2005-2014 from 1997-1999 (Table 7.3). Declines were noted for both the numbers of kept and discards of almost all species examined including swordfish, tunas, sharks, billfish, and sea turtles. The only positive changes from the base period were the numbers of bluefin tuna and dolphin kept and bluefin tuna, large coastal sharks, and spearfish discards. The reported number of bluefin tuna kept increased by 57.9 percent for 2005-2014 compared to 1997-1999 (Table 7.3). The number of reported discards of bluefin tuna increased by 3.9 percent between the same time periods, which is less than the predicted 10.7 percent increase from the analyses in Regulatory Amendment 1. The number of dolphin kept increased by 7.2 percent (Table 7.3). Reported billfish (blue marlin, white marlin, and sailfish) discards decreased by 50 - 64 percent from 1997-1999 to 2005-2013 (Table 7.4). The reported discards of spearfish increased by 12 percent, although the absolute number of discards was low. The reported number of turtle interactions decreased by 73 percent from 1997-1999 to 2005-2014.

The reported declines in swordfish kept and discarded, large coastal sharks kept, and BAYS tuna kept decreased more than the predicted values developed for Regulatory Amendment 1. Reported discards of pelagic sharks, all billfish (with the exception of spearfish for which no predicted change was developed in Regulatory Amendment 1), and turtle interactions also

declined more than the predicted values. The number of large coastal shark discards increased slightly from 1997-1999 to 2005-2014. The numbers of bluefin tuna discards and dolphin kept have increased.

The reported distribution of effort over the same time periods was also examined for changes in fishing behavior (Table 7.5). Declines in the number of hooks set were noted for all areas with the exception of the Sargasso (SAR) area, where reported effort has increased more than ten-fold from the period between 1997 and 1999. However, this effort represents only 2.7 percent of the overall effort reported in the fishery. Effort also increased in the Florida East Coast (FEC) area by 15.5 percent and in the South Atlantic Bight (SAB) by 6.9. Overall, reported effort decreased by 23.7 percent from 1997-1999 to 2005-2014. Reported effort declined by 40 percent or more in all other areas with the exception of the Gulf of Mexico. As a result of the Deepwater Horizon/BP oil spill in the Gulf of Mexico and the subsequent closures, reported effort for 2010 was dramatically reduced, less than one third of the reported effort of the previous year (2009). Reported effort in 2012 increased since 2011, but declined slightly in 2013 and declined further in 2014. Reported effort declined by 62.7 percent in the SAT area (Tuna North and Tuna South combined), but this represents less than three percent of total reported effort. Reported effort in the Caribbean area (CAR) declined by over 80 percent in 2005-2014 from 1997-99, but this area accounts for less than one percent of the total effort.

Concern over the status of bluefin tuna and the effects of the PLL fishery on bluefin tuna led to a re-examination of a previous analysis which compared the reported catch and discards of select species or species groups from the MAB and NEC to that reported from the rest of the fishing areas (Table 7.6). The number of bluefin tuna discards reported from the MAB/NEC had been increasing from 2006-2010 but decreased beginning in 2011 and has stayed low since. The number of bluefin tuna kept decreased to 55 in 2013 and was up to 104 in 2014. The discards from the other areas have remained relatively constant, fluctuating between 100 and 300 for the past 10 years. The level of bluefin tuna discards in the MAB/NEC does not appear to be effort-related as the reported number of hooks set has been relatively stable (MAB) or in decline (NEC).

Table 7.3 Number of Swordfish, Bluefin Tuna, Yellowfin Tuna, Bigeye Tuna, and Total BAYS (Bigeye, Albacore, Yellowfin and Skipjack Tuna) Reported Landed or Discarded in the U.S. Atlantic Pelagic Longline Fishery (1997–2014) and Percent Changes Since 1997-99

Year	Number of Hooks Set (x1000)	Swordfish Kept	Swordfish Discards	Bluefin Tuna Kept	Bluefin Tuna Discards	Yellowfin Tuna Kept	Yellowfin Tuna Discards	Bigeye Tuna Kept	Bigeye Tuna Discards	Total BAYS Kept	Total BAYS Discards
1997-99	8,533.1	69,131	21,519	238	877	72,342	2,489	21,308	1,133	101,477	4,224
(A) 2001-03	7,364.1	50,838	13,240	212	607	55,166	1,827	13,524	395	76,116	3,069
2004	7,325.9	46,950	10,704	476	1,031	64,128	1,736	8,266	486	77,989	3,452
2005	5,922.6	41,239	11,158	376	766	43,833	1,316	8,383	369	57,237	2,545
2006	5,662.0	38,241	8,900	261	833	55,821	1,426	12,491	257	73,058	2,865
2007	6,290.6	45,933	11,823	357	1,345	56,062	1,452	8,913	249	70,390	3,031
2008	6,498.1	48,000	11,194	343	1,417	33,774	1,717	11,254	356	50,108	3,427
2009	6,978.9	45,378	7,484	629	1,290	40,912	1,701	10,379	397	57,461	3,555
2010	5,729.1	33,813	6,107	392	1,488	32,567	748	12,561	476	51,786	1,590
2011	5,914.5	38,012	8,510	355	764	40,993	728	16,338	453	68,401	2,850
2012	7,678.5	51,544	7,996	392	563	59,188	1,046	14,841	459	84,707	3,113
2013	7,305.9	44,556	4,765	273	266	39,988	941	15,472	513	67,073	2,376
2014	7,125.2	32,908	4,655	379	380	41,799	647	17,020	459	73,339	1,973
(B) 2005-14	6,510.5	41,962	8,282	376	911	44,494	1,172	12,765	399	65,356	2,733
% dif (A)	-13.7	-26.5	-38.5	-10.9	-30.8	-23.7	-26.6	-36.5	-65.1	-25.0	-27.3
% dif (B)	-23.7	-39.3	-61.5	57.9	3.9	-38.5	-52.9	-40.1	-64.8	-35.6	-35.3
Pred [1]		-24.6	-41.5		-1.0					-5.2	
Pred [2]		-13.0	-31.4		10.7					10.0	

(A) and (B) are average values for the years indicated. Predicted values from Regulatory Amendment 1, where Pred 1 = without redistribution of effort, Pred 2 = with redistribution of effort. Source: Fisheries Logbook System.

Table 7.4 Number of Pelagic Sharks, Large Coastal Sharks, Dolphinfish, and Wahoo Reported Landed or Discarded and Number of Billfish (Blue and White Marlin, Sailfish, and Spearfish) and Sea Turtles Reported Caught and Discarded in the U.S. Atlantic Pelagic Longline Fishery (1997–2014) and Percent Changes Since 1997-99

Year	Pelagic Sharks Kept	Pelagic Shark Discards	Large Coastal Sharks Kept	Large Coastal Shark Discards	Dolphinfish Kept	Dolphinfish Discards	Wahoo Kept	Wahoo Discards	Blue Marlin Discards	White Marlin Discards	Sailfish Discards	Spearfish Discards	Sea Turtles
1997-99	3,898	52,093	8,860	6,308	39,711	608	5,172	175	1,621	1,973	1,342	213	596
(A) 2001-03	3,237	23,017	5,306	4,581	29,361	322	3,776	74	815	1,045	341	139	429
2004	3,460	25,414	2,304	5,144	39,561	295	4,674	35	713	1,060	425	172	370
2005	3,150	21,560	3,365	5,881	25,709	556	3,360	280	569	990	367	155	154
2006	2,098	24,113	1,768	5,326	25,658	1,041	3,608	100	439	557	277	142	128
2007	3,504	27,478	546	7,133	68,124	467	3,073	52	611	744	321	147	300
2008	3,500	28,786	115	6,732	43,511	404	2,571	82	686	669	505	196	476
2009	3,060	33,721	403	6,672	62,701	433	2,648	81	1,013	1,064	774	335	137
2010	3,872	45,511	434	6,726	30,454	174	749	26	504	605	312	212	94
2011	3,694	43,778	130	6,085	29,442	335	1,848	50	539	921	556	281	66
2012	2,794	23,038	86	7,716	42,445	432	3,121	92	843	1,432	767	270	61
2013	3,394	28,800	50	8,629	34,250	181	2,721	59	844	1,239	456	342	92
2014	3,851	38,496	47	5,880	63,217	205	3,235	74	718	1,580	445	306	93
(B) 2005-14	3,297	31,531	694	6,705	42,551	424	2,693	90	682	982	488	239	160
% diff (A)	-17.0	-55.8	-40.1	-27.4	-26.1	-47.0	-27.0	-57.7	-49.7	-47.0	-74.6	-34.7	-28.0
% diff (B)	-15.6	-39.5	-92.2	6.3	7.2	-30.3	-47.9	-47.4	-57.9	-50.2	-64.0	12.0	-73.1
Pred [1]	-9.5	-2.0	-32.1	-42.5	-29.3				-12.0	-6.4	-29.6		-1.9
Pred [2]	4.1	8.4	-18.5	-33.3	-17.8				6.5	10.8	-14.0		7.1

(A) and (B) are average values for the years indicated. Predicted values from Regulatory Amendment 1 where Pred [1] = without redistribution of effort, Pred [2] = with redistribution of effort. Source: Fisheries Logbook System.

Table 7.5 Reported Distribution of Hooks Set by Area (1997-2014) and Percent Change Since 1997-99

Year	CAR	GOM	FEC	SAB	MAB	NEC	NED	SAR	NCA	SAT	Total
1997-99	328,110	3,346,298	722,580	813,111	1,267,409	901,593	511,431	14,312	191,478	436,826	8,533,148
(A) 2001-03	175,195	3,682,536	488,838	569,965	944,929	624,497	452,430	76,130	222,070	127,497	7,364,086
2004	298,129	4,118,468	264,524	672,973	856,521	462,171	455,862	128,582	20,990	47,730	7,325,950
2005	180,885	3,037,968	323,551	467,680	835,091	356,696	462,490	110,107	55,716	92,382	5,922,566
2006	73,774	2,577,231	281,239	544,647	1,085,640	406,199	339,586	135,575	64,500	153,620	5,662,011
2007	32,650	2,914,475	345,486	737,873	1,319,056	326,532	285,827	100,336	11,409	207,598	6,281,242
2008	87,190	2,368,381	642,846	846,984	1,423,136	579,244	224,635	147,969	16,148	152,763	6,489,246
2009	34,783	3,037,197	830,348	847,525	1,199,657	481,110	262,003	107,172	0	179,152	6,978,947
2010	77,710	1,005,764	1,097,929	1,002,748	1,295,242	657,892	211,465	141,713	3,096	235,553	5,729,112
2011	29,600	1,247,892	1,129,555	984,858	1,330,542	665,706	173,038	206,923	11,270	135,069	5,914,453
2012	7,200	2,655,468	1,285,060	937,946	1,513,367	787,681	127,044	171,177	3,300	190,211	7,678,454
2013	38.090	2,304,802	1,239,326	1,185,433	1,450,434	516,159	152,896	242,920	11,758	164,079	7,305,897
2014	21,390	2,219,684	1,171,402	1,133,640	1,232,857	507,525	343,220	367,598	10,530	117,377	7,125,223
(B) 2005-14	58,327	2,336,8864	834,674	868,933	1,268,502	528,474	258,220	173,149	18,773	162,780	6,508,715
% diff (A)	-46.6	10.0	-32.3	-29.9	-25.4	-30.7	-11.5	431.9	16.0	-70.8	-13.7
% diff (B)	-82.2	-30.2	15.5	6.9	0.1	-41.4	-49.5	1,109.8	-90.2	-62.7	-23.7

(A) and (B) are average values for the years indicated. CAR – Caribbean; GOM - Gulf of Mexico; FEC - Florida East Coast; SAB - South Atlantic Bight; MAB - Mid-Atlantic Bight; NEC - Northeast Coastal; NED - Northeast Distant; SAR - Sargasso; NCA - North Central Atlantic; SAT - Tuna North & Tuna South. Source: Fisheries Logbook System.

Table 7.6 Number of Bluefin Tuna, Swordfish, Pelagic and Large Coastal Sharks, Billfish, and Sea Turtles Reported Kept and/or Discarded in the Mid-Atlantic Bight and Northeast Coastal Areas Combined (1997-2014)

Year	Hooks Set (x1000)	BFT Kept	BFT Discards	SWO Kept	SWO Discards	PEL Shark Kept	PEL Shark Discards	LCS Kept	LCS Discards	Billfish Discards	Sea Turtle Interactions
1997	2,441.1	96	583	6,330	3,663	3,062	40,515	6,670	958	803	52
1998	2,207.4	94	1,157	9,684	4,923	2,143	28,579	1,781	890	401	57
1999	1,858.5	70	335	8,213	4,331	1,680	12,479	1,966	736	818	174
2000	1,645.4	26	356	8,748	2,846	2,099	13,083	4,744	1,407	240	30
2001	1,975.3	45	200	10,661	4,000	2,537	9,013	4,383	997	310	69
2002	1,582.3	18	389	10,986	4,219	2,378	7,308	2,331	1,207	311	41
2003	1,150.7	67	471	10,888	3,022	2,222	6,929	2,787	1,429	172	42
2004	1,318.7	128	709	8,486	2,463	2,323	7,594	923	1,488	219	54
2005	1,191.8	96	575	9,184	2,420	1,912	7,026	2,512	2,433	473	44
2006	1,491.8	124	737	10,278	2,564	1,428	7,547	1,279	2,180	266	28
2007	1,645.6	137	1,148	14,102	3,082	2,313	8,169	431	2,861	407	55
2008	2,002.5	143	1,133	13,208	3,199	2,695	9,541	63	1,781	320	100
2009	1,608.8	137	952	12,657	1,896	2,256	14,113	206	2,210	299	16
2010	1,953.1	155	1,301	9,090	1,546	3,326	17,033	408	2,293	376	32
2011	1,996.3	168	583	9,995	2,474	2,793	19,867	90	1,809	497	28
2012	2,301.1	102	270	12,597	1,396	2,199	13,535	9	1,972	650	16
2013	1,966.6	55	107	9,806	2,766	2,711	17,958	9	1,366	693	31
2014	1,740.4	104	122	5,027	1,015	3,115	16,405	6	1,050	710	18

BFT - Bluefin tuna; SWO – Swordfish; PEL – Pelagic sharks; LCS - Large coastal sharks; MAB - Mid-Atlantic Bight; NEC - Northeast Coastal. Source: Fisheries Logbook System.

Table 7.7 Number of Bluefin Tuna, Swordfish, Pelagic and Large Coastal Sharks, Billfish, and Sea Turtles Reported Kept and/or Discarded in All Areas Other than the Mid-Atlantic Bight and Northeast Coastal (1997-2014)

Year	Hooks Set (x1000)	BFT Kept	BFT Discards	SWO Kept	SWO Discards	PEL Shark Kept	PEL Shark Discards	LCS Kept	LCS Discards	Billfish Discards	Turtle Interactions
1997	7,233.5	111	123	62,892	16,892	2,048	41,507	7,076	6,911	6,091	215
1998	5,823.9	143	164	60,943	18,422	1,588	16,682	4,677	4,687	3,364	833
1999	6,035.1	200	269	59,331	16,325	1,172	16,516	4,409	4,741	3,968	458
2000	6,376.5	210	382	54,787	13,860	969	14,965	3,014	5,320	3,394	241
2001	5,767.0	138	148	38,575	10,448	974	14,941	2,127	3,895	1,723	352
2002	5,647.3	160	204	39,453	8,963	693	15,160	1,746	2,761	2,866	426
2003	5,969.7	208	410	41,950	9,067	907	14,842	2,565	3,453	1,641	357
2004	6,007.3	348	322	38,464	8,241	1,137	17,820	1,381	3,656	2,151	316
2005	4,730.8	280	191	32,055	8,738	1,238	14,534	853	3,448	1,608	110
2006	4,170.2	137	96	27,963	6,336	670	16,566	489	3,146	1,149	100
2007	4,645.1	200	197	31,831	8,741	1,191	19,309	115	4,272	1,416	245
2008	4,495.7	200	284	29,592	7,995	805	19,245	52	4,951	1,736	376
2009	5,298.2	492	338	32,721	5,588	804	16,608	197	4,462	2,887	121
2010	3,775.9	237	187	24,723	4,561	546	28,478	26	4,433	1,257	62
2011	3,918.2	187	181	28,017	6,036	901	23,911	40	4,276	1,800	38
2012	5,377.4	290	293	38,947	6,600	595	9,503	77	5,744	2,743	45
2013	5,339.3	218	159	34,750	2,583	683	9,842	41	7,263	2,190	61
2014	5,384.8	275	258	27,881	3,640	689	22,101	41	4,855	2,339	77

BFT - Bluefin tuna; SWO – Swordfish; PEL – Pelagic sharks; LCS - Large coastal sharks; MAB - Mid-Atlantic Bight; NEC - Northeast Coastal. Source: Fisheries Logbook System.

7.5.1 Conclusion

The time/area closures and live bait prohibition in the Gulf of Mexico have been successful at reducing bycatch in the HMS pelagic longline fishery. Reported discards of all species of billfish except spearfish have declined. The reported number of turtles caught, swordfish discarded, and pelagic and large coastal shark discards have also declined. However, the number of bluefin tuna discarded has increased.

7.6 Evaluation of Other Bycatch Reduction Measures

NMFS continues to monitor and evaluate bycatch in HMS fisheries through direct enumeration (pelagic and bottom longline observer programs, shark gillnet observer program), evaluation of management measures (closed areas, trip limits, gear modifications, etc.), and VMS.

Chapter 7 References

Angliss, R.P. and D.P. DeMaster. 1998. Differentiating serious and non-serious injury of marine mammals taken incidental to commercial fishing operations. NOAA Technical Memorandum NMFS OPR-13: 48 p.

Cortés, E. 2005. Stock assessment of small coastal sharks in the U.S. Atlantic and Gulf of Mexico. NOAA, NMFS, Southeast Fisheries Science Center, Panama City, FL. SFD-02/03-177. 222 pp.

Cortés, E. and I. Baremore. 2011. Updated catches of sandbar, dusky, and blacknose sharks. SEDAR21-DW-09.

de Silva, J.A., R.E. Condrey, B.A. Thompson. 2001. Profile of shark bycatch in the U.S. Gulf menhaden fishery. North Amer. Jour. of Fish. Mgmt. 21:111-124.

Mathers, A.N., B.M. Deacy, M.S. Passeroti, and J.B. Carlson. 2014. Catch and bycatch in U.S. southeast gillnet fisheries, 2013. NOAA Tech Memo. NMFS-SEFSC-657. 24 p.

NMFS. 1998. Managing the nation's bycatch: programs, activities, and recommendations for the National Marine Fisheries Service. USDOC, NOAA, NMFS, Silver Spring, MD, 192 p.

NMFS. 1999. Final fishery management plan for Atlantic tunas, swordfish and sharks. NOAA, NMFS, HMS Management Division.

NMFS. 2000. Regulatory amendment 1 to the 1999 HMS FMP: reduction of bycatch, bycatch mortality, and incidental catch in the Atlantic pelagic longline fishery, June 14, 2000. NOAA, NMFS, HMS Management Division.

NMFS. 2002. Regulatory adjustment 2 to the Atlantic tunas, swordfish, and sharks fishery management plan. USDOC, NOAA, NMFS, Highly Migratory Species Management Division, 174 p.

NMFS. 2003. Final amendment 1 to the fishery management plan for Atlantic tunas, swordfish, and sharks. USDOC, NOAA, NMFS, Highly Migratory Species Management Division, 1315 East West Highway, Silver Spring, MD.

NMFS. 2004. Evaluating Bycatch: A national approach to standardized bycatch monitoring programs. USDOC, NOAA Tech. Memo. NMFS-F/SPO-66, 108 p.

NMFS. 2006. Final consolidated Atlantic highly migratory species fishery management plan. NOAA, NMFS, Highly Migratory Species Management Division, 1315 East West Highway, Silver Spring, MD.

NMFS. 2011a. Stock assessment and fishery evaluation (SAFE) report for Atlantic highly migratory species. Highly Migratory Species Management Division, 1315 East West Highway, Silver Spring, MD 20910.

NMFS. 2011b. US National Bycatch Report. Karp, W.A.L.L. Desfosse and S.G. Brooke, eds. USDOC NOAA TM NMFS-F/SPO-117E, 508 p.

NMFS. 2013. Annual report of the United States to ICCAT. USDOC, National Marine Fisheries Service. ANN/045/2012.

Rago, P.J., S.E. Wigley, and M.J. Fogarty. 2005. NEFSC bycatch estimation methodology: allocation, precision, and accuracy. USDOC, Northeast Fish Sci Cent Ref Doc. 05-09; 44 p.

Ryder, C.E., T.A. Conant, and B.A Schroeder. 2006. Report of the workshop on marine turtle longline post-interaction mortality. USDOC, NOAA Tech. Mem. NMFS-F/OPR-29.

SEDAR 11. 2006. Stock assessment report: large coastal shark complex, blacktip, and sandbar shark. NOAA/NMFS, Highly Migratory Species Management Division, 1315 East West Highway, Silver Spring, MD.

SEDAR 13. 2007. Stock assessment report: small coastal shark complex, Atlantic sharpnose, blacknose, bonnethead, and finetooth shark. NOAA/NMFS, Highly Migratory Species Management Division, 1315 East West Highway, Silver Spring, MD.

SEDAR 34a. 2013. Stock assessment report: HMS Atlantic sharpnose shark. SEDAR, SAR Section II, 242 p.

SEDAR 34b. 2013. Stock assessment report: HMS Bonnethead shark. SEDAR, SAR Section II, 222 p.